Executive Summary

Background

The state of Florida requires the South Florida Water Management District (SFWMD) to develop Minimum Flows and Levels (MFLs) for priority water bodies within its jurisdiction. MFLs are developed pursuant to the requirements contained in Sections 373.042 and 373.0421 of Florida Statutes (F.S.). The minimum flow is defined as the ". . . limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area." The minimum level is defined as the ". . . limit at which further withdrawals would be significantly harmful to the water resources of the area." (Section 373.042(1), F.S.). Significant harm, as defined by the SFWMD in the Florida Administrative Code (F.A.C.) Section 40E-8.021(24), means the temporary loss of water resource functions, which result from a change in surface or ground water hydrology, that takes more than two years to recover, but which is considered less severe than serious harm. Technical supporting documentation, including scientific and technical data, methodologies, models and assumptions, is developed for each water body and subject to scientific peer review (Chapter 373.042(4) F.S.). The specific water resource functions addressed by a MFL and the duration of the recovery period associated with significant harm are established by rule (Chapter 40E-8 F.A.C.) for each priority water body.

To support the adoption of the existing MFL rule for the Caloosahatchee River, the District compiled results of previous and ongoing studies, initiated additional research, analyzed and interpreted data necessary to develop "technical criteria" for the Caloosahatchee River and Estuary (**Figure ES-1**) and determine low water flows that may cause significant harm to water resources. The resource at greatest risk for impact was identified as an existing 640-acre bed of aquatic vegetation, *Vallisneria americana*, commonly known as tapegrass or wild celery, located downstream of the S-79 water control structure. The final rule, which was adopted by the SFWMD in September 2001 and later incorporated into Chapter 40.E.8. F.A.C., included flow criteria for S-79 and salinity criteria in the vicinity of the vegetation bed, expressed as follows:

> "A MFL exceedance occurs during a 365-day period, when (a) a 30-day average salinity concentration exceeds 10 parts per thousand at the Ft. Myers salinity station (measured at 20% of the total river depth from the water surface at a location latitude 263907.260, longitude 815209.296) or (b) a single, daily average salinity exceeds a concentration of 20 parts per thousand at the Ft. Myers salinity station. Exceedance of either subsection (a) or subsection (b), for two consecutive years is a violation of the MFL." (Chapter 40.E.8.221(2) F.A.C.)

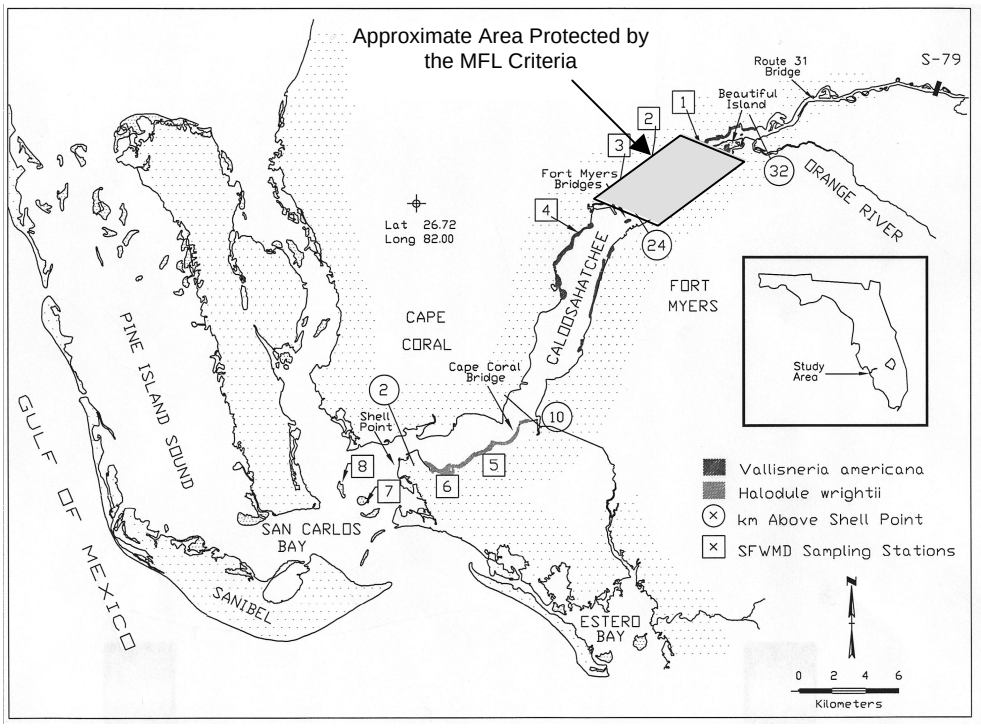

Figure ES-1. Location of the Caloosahatchee River, including major features, natural distribution of submerged aquatic vegetation and related sampling sites.

The MFL study indicated that the proposed criteria for the Caloosahatchee River and Estuary will be exceeded on a regular and continuing basis until additional storage is provided in the basin to supply the additional water needed. Therefore, the MFL document also included a recovery and prevention strategy, which was incorporated into the rule (Ch. 40E-8.421, FAC). Projects in the C-43 basin (reservoirs, aquifer storage and recovery wells) associated with the Comprehensive Everglades Restoration Plan (CERP) and Lower West Coast Regional Water Supply Plan (LWCRWSP), revised operational protocols for existing and new facilities, and modifications to SFWMD consumptive use permitting and water shortage rules and regulations, comprise the recovery and prevention strategy. These combined efforts are designed to supply the water necessary, over time, to achieve the minimum flow criteria.

Purpose and Scope

The MFL Rule, in Section 40E-8.011(3), F.A.C., also states that the minimum flow criteria for the Caloosahatchee River and Estuary shall be reviewed by the SFWMD, based on best available information, within one year of the effective date of the rule and amended as necessary. The purpose of this document is therefore to re-examine the technical and scientific basis of the Caloosahatchee minimum flows based on comments provided by an independent scientific peer review panel and results obtained from additional field observations, laboratory experiments, and numerical model development

that have been obtained since adoption of the rule in 2001. The review specifically evaluates the ability of the 300 cfs discharge at Structure S-79 to protect the 640-acre bed of *Vallisneria americana.* This report documents the methods and results of these studies, management implications, and additional investigations that are needed to further refine the recovery and prevention strategy.

In September 2000, the scientific peer review panel reviewed and approved the general scientific approach used in establishing the MFL. However, specific scientific deficiencies in the technical documentation of the rule were identified. Major concerns with the initial effort were as follows:

1. Lack of a hydrodynamic/salinity model
2. Lack of a numerical population model for *Vallisneria americana*
3. No quantification of the habitat value of *Vallisneria* beds
4. Lack of documentation of the effects of MFL flows on downstream estuarine biota

A research program was initiated during 2001 to address these concerns, which included additional field observations, laboratory experiments and development of modeling tools. This program is still in progress. The scope of the review includes the following

1. Examine effects of low level freshwater flows on other organisms that are characteristic of the Caloosahatchee Estuary, especially those located downstream in more marine areas. This analysis tests a basic assumption of the Valued Ecosystem Component (VEC) approach: flows or salinities appropriate for VEC are not detrimental to other important estuarine organisms. This part of the review relied on analyses of data from long-term monitoring of plankton and fish larvae, as well as on recently conducted ecological studies of the American Oyster.
2. Evaluate the salinity tolerance of *Vallisneria americana* as it relates to the salinity criteria of the MFL Rule. Additional field observations and results of laboratory experiments conducted in the past year were analyzed for this purpose.
3. Review the relationship between freshwater inflow and salinity in the Caloosahatchee based on (1) a mass-balance, hydrodynamic model that is currently under development and (2) newly available estimates of freshwater inflows from the tidal basin downstream of S-79.
4. Review the MFL recovery strategy for the Caloosahatchee River and Estuary. The hydrodynamic model and modeled estimates of tidal basin were used to evaluate the ability of CERP projects to (1) provide total flows to the estuary, (2) distribute total flow between sources upstream of S-79 and the downstream tidal basin, and (3) affect the spatial distribution and temporal variability of salinity in the Caloosahatchee Estuary. A numerical

population model of *Vallisneria americana*, also under development, was used to determine whether these projects improve conditions for *Vallisneria*.

Due to time limitations, this review did not address the habitat value of *Vallisneria* beds. This issue is being investigated through a three-year contract with Mote Marine Laboratory, which began in January of 2002. The overall objective of the contract is to identify which organisms use *Vallisneria* habitat in the Caloosahatchee River and how season, salinity, flow, and plant /bed morphometry affect habitat use.

Conclusions

Valued Ecosystem Component Approach:

The Caloosahatchee MFL is intended to establish a salinity environment that indicates conditions that will result in significant harm to submerged *Vallisneria americana* grass beds in the upper estuary. A major assumption of this approach is that salinity and flow conditions that protect *V. americana* will also protect other key organisms in the estuary. Previous work on this subject (Chamberlain and Doering 1998) and results presented in this review support the validity of this assumption. MFL flows of about 300 cfs were not harmful to zooplankton and ichthyoplankton (fish larvae) or to oysters (Crassostrea virginica) living in the downstream higher salinity portions of the estuary. However, lower flows (less than 300 cfs) have been associated with phytoplankton blooms in the upper estuary that could result in water quality problems such as depressed oxygen levels. While evidence indicates that low flows in the 300 cfs range are not harmful, high flows above 2500 – 3000 cfs appear detrimental. This high flow limit agrees with previous estimates (Chamberlain and Doering 1998; Doering et al. 2002).

Salinity Criteria

The Caloosahatchee MFL Rule contains two salinity criteria at the Ft. Myers salinity monitoring site: a 30-day moving average salinity of 10 parts per thousand (ppt) and a daily average salinity of 20 ppt. The summary of published information and the results of investigations by District staff presented here agree that these are sound physiological and ecological thresholds for *V. americana*. The combination of results from field monitoring and laboratory experiments conducted by District and other investigators agree that 10 ppt is a critical threshold salinity for growth. Salinities above 15 ppt cause mortality. The 30-day moving average, as presented in the MFL rule, is consistent with laboratory experiments, which show that *Vallisneria* can survive exposure to 10 ppt for periods exceeding one month. The daily average maximum salinity limit of 20 ppt was included in the rule to avoid acute exposure to high salinity levels. Laboratory experiments conducted by District Staff indicate that a one day exposure to 20 ppt is a reasonable limit for acute exposure. Analysis of 11 years of salinity data demonstrates that in practice, the acute criterion is never exceeded before the 30-day moving average criterion.

Salinity and Freshwater Inflow

A thorough understanding of the relationship between freshwater inflow and the spatial distribution of salinity in the estuary is key to establishing an MFL. Over the past year, two new modeling tools have been developed to investigate this relationship. The Caloosahatchee Tidal Basin Model allows estimation of freshwater inflows down stream of S-79. The Caloosahatchee Hydrodynamic Model is a numerical, mass balanced, 3-dimensional model that estimates the distribution of salinity in the estuary under different freshwater inflow conditions. While both of these tools are still under development, they can be used to relate salinity in the estuary to total inflow (i.e. discharge at S-79 + downstream tidal basin inflows).

The greatest uncertainty in this analysis lies in the relationship between freshwater inflow and the distribution of salinity levels in the estuary. A mass balanced hydrodynamic model is the modeling tool of choice because all inflows need to be quantified and specified. In terms of development, the mass balance hydrodynamic model employed here is in its infancy. The current model uses existing (woefully inadequate) bathymetry. A new bathymetric survey for the Caloosahatchee Estuary will be available soon and incorporated into the model. The model was not calibrated with tidal basin inflows, which are themselves uncertain. The model was calibrated using a very a limited set of hydrologic conditions.

The major conclusions of the salinity and flow modeling effort are that the MFL is not currently being met and a recovery and prevention strategy is required. This conclusion is consistent with the initial technical documentation. Construction of reservoirs and other projects in the C-43 basin being completed under the CERP comprise the existing recovery strategy.

Downstream tidal basin inflows are an important supplement to flows at S-79. Under current conditions, for 300 cfs released at S-79 to produce 10 ppt at Ft. Myers, additional inflow from the downstream tidal basin is required. This additional inflow may be on the order of 200 cfs (total = 500 cfs) but this is uncertain. Whatever downstream contribution is needed, both the original regression analysis and the modeling approach presented here suggest that under current conditions a 300 cfs discharge at S-79 will, on average, produce a salinity of 10 ppt at Ft. Myers.

However, a 300 cfs discharge at S-79 is less likely to achieve 10 ppt under dry conditions when downstream inflows are below average. The effect of downstream, tidal basin inflows on the ability to achieve MFLs has two important ramifications. Under present conditions, releases of 300 cfs at S-79 from Lake Okeechobee may not produce the desired salinity in the estuary if these releases are made during dry periods when contributions from downstream tidal basin are below normal. The same constraint applies after CERP components are built. Releases of 300 cfs from reservoirs and ASR facilities may not satisfy MFL salinity criteria during dry periods when tidal basin inflows are low or absent. Overall, modeling

results show that CERP components improve salinity conditions in the downstream estuary. The percentage of total flows that are less than 500 cfs decreases by half when these facilities are completed.

Resource Based Evaluation of the Recovery Strategy:

Modeling studies of *V. americana* shoot density were undertaken to estimate data for two monitoring sites. Site 1 (Bird Island) is located approximately 30 km upstream from Shell Point and Site 2 is located approximately 26 km upstream from Shell Point (**Figure ES-1**). Both sites are within the area designated for protection of *V. americana.* Results of this study indicate that the MFL is not presently being met and an inadequate level of resource protection exists. On the other hand, the results for *V. americana* shoot densities indicate that the CERP components may afford some level of resource protection at these two sites. Since Site two is located at 26 km upstream of Shell Point, the results suggest that CERP may provide resource protection over about two-thirds of the area set aside for protection of *V. americana* (24 – 30 km). Simulations using the hydrodynamic-salinity model indicate that exceedances of the 30-day average MFL salinity criterion occur at Site 1 and Site 2 even with CERP components in place. These exceedances are of less magnitude and duration than those that currently occur. Results from *the V. americana* model further indicate that the 10 ppt criterion provides appropriate protection of the resource from significant harm.

Recommendations

- Continue to apply the present MFL criteria while completing ongoing efforts to further refine and calibrate the models and collect additional monitoring data.
- Results of these studies suggest that changes may be needed to storage facilities in the watershed and/or regional water delivery protocols to provide more freshwater to protect the *V. americana* community from significant harm.
- However, before any decisions are made to modify CERP projects or the MFL criteria, the models need to be completed and fully calibrated and improved flow measurements need to be obtained, especially for downstream tidal basin inflows.
- CERP, the Southwest Florida Feasibility Study, and RECOVER need to consider the implications of these MFL studies which, when complete, may suggest that different management approaches and/or performance measures are needed to protect the resource from significant harm.
- Once restoration needs for this system have been defined as a result of the Southwest Florida Feasibility Study, and reservations have been defined to meet restoration needs, the existing MFL criteria may need to be modified, over time, to protect restored resources from significant harm.